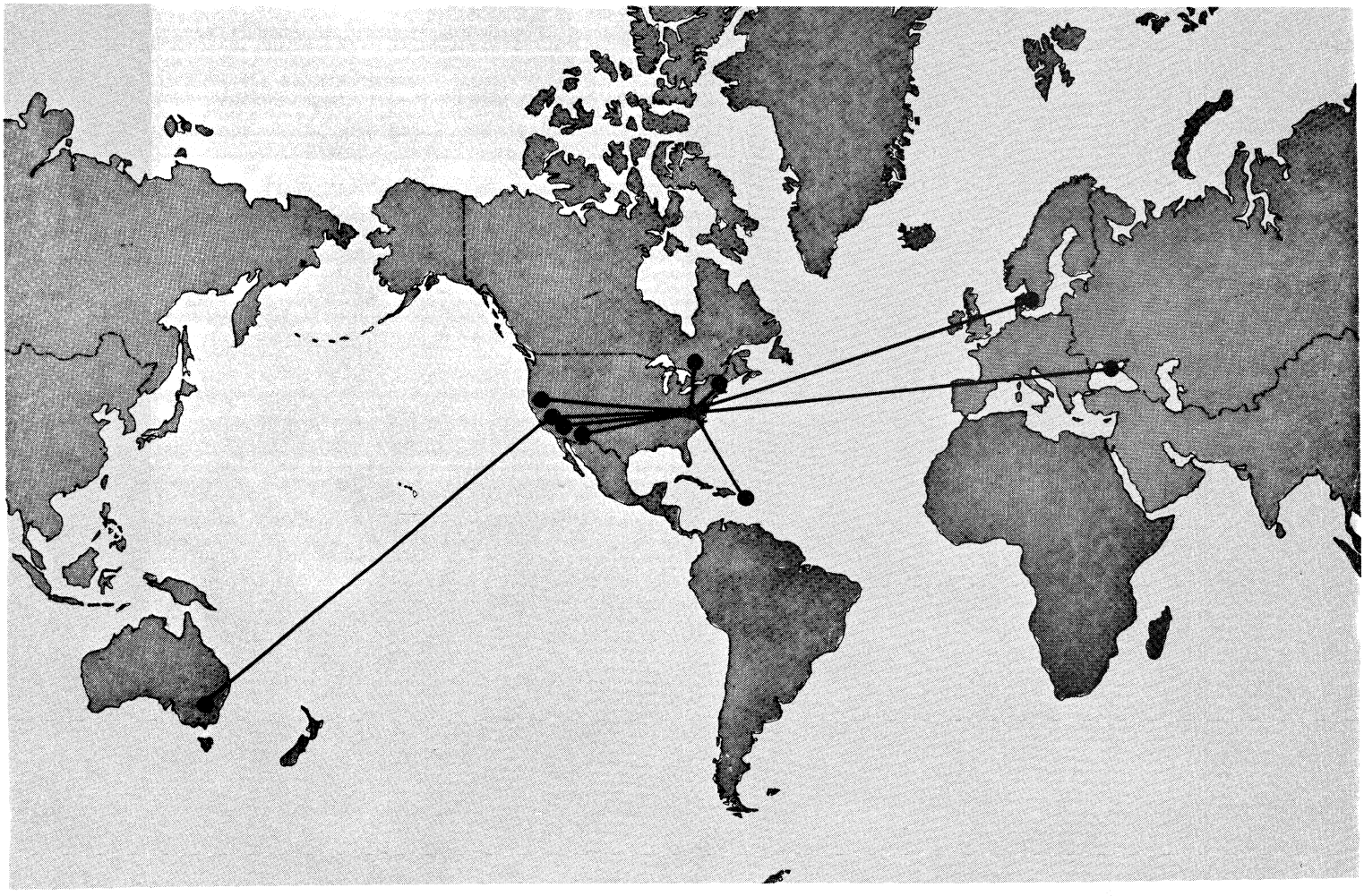
The OBSERVER

Vol. 12, No. 3 May 1971 Page 1



The Very Long Baseline Network
(Story of page 2).

THE SECOND SOVIET-AMERICAN VLB EXPERIMENT

K. I. Kellermann

Following the "successful" completion of our first joint VLB experiments with the USSR, plans were made for a repeat performance. Our Soviet colleagues agreed to prepare maser preamplifiers for 3.5 and 2.8 cm and for 8 mm to increase both the sensitivity and angular resolution. On our part we were supposed to provide the new improved MK II VLB recording system (see George Grove's article, p. 23). Although we originally had planned to begin our observations sometime in 1970, progress was not as rapid as hoped and, as of this writing, neither the masers nor the MK II recorder terminals have been fully tested.

Nevertheless, several months ago we optimistically scheduled an observing period between Green Bank and Crimea at 2.8 cm for mid-May, and a second experiment at 3.5 cm to include the Goldstone 210', Green Bank, and Crimea.

To avoid the many difficulties we experienced before transporting our clock, Mike Balister was commissioned to develop a portable clock capable of running off 115 or 230 VAC, 12 VDC, or an internal battery supply. There was also some discussion of providing a hand-cranked generator in case all else failed.

From a telephone conversation with Moscow in late March we learned that although preparations in Russia were "All OK", "it would be better" if Barry Clark were to delay his arrival date planned for late April. And when our Soviet entry visas arrived valid only after May 15, it became clear that we would not be able to meet the scheduled May 18 observing date at 2.8 cm.

Telescope schedules being what they are, we proposed cancelling the 2.8 cm experiment to concentrate on 3.5 cm, and this plan was agreed to by the Russians. However, we later learned that the Russian 2.8 cm maser is completed although the 3.5 cm one is not. On our end we are still waiting for delivery of the mixer-preamplifier unit needed as part of the receiver, and Barry Clark is busy with last minute preparations of the MK II VLB system.

Provided that from now on things run more smoothly than previous experience indicates they will, the first observations will be made in late May, so that by the next issue there will be more to report.

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A special thanks to all of those who helped assemble the OBSERVER.

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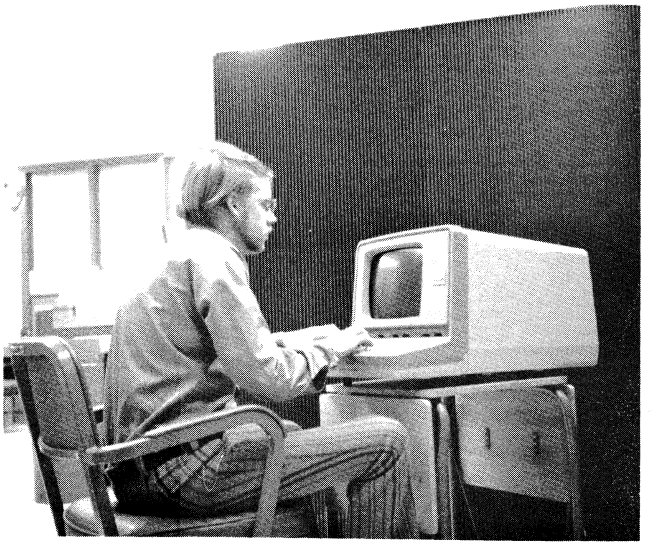
COMPUTERS FOR THE LAYMAN

George Conant

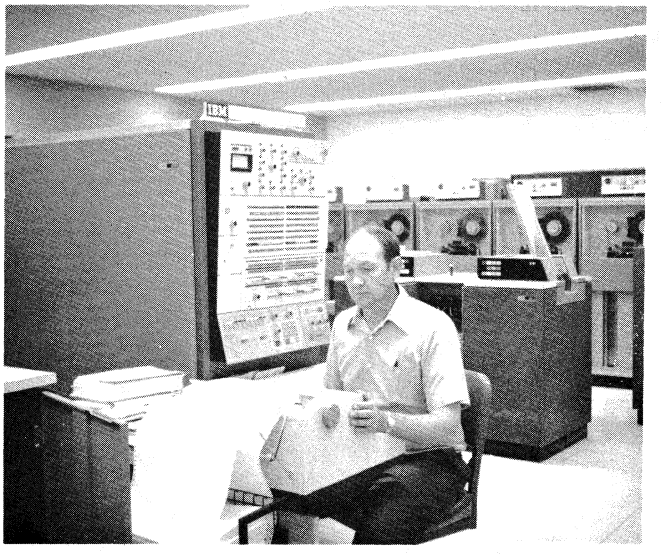
Part I. An Unfishy Computer Story for non-Astronomers

Was something fishy going on in Charlottesville? Over the past few weeks many NRAO people, and some of their families, glimpsed demonstrations of one or two strange devices, each having a typewriter keyboard in front but, otherwise, looking vaguely like a small television set.

If you watched the demonstration, you noticed that these particular "boob tubes" didn't produce much of a picture. A printed message, made up of capital letters, numbers, and a few punctuation marks, was all that they could display on their "black and white" screen. If you typed a message on the keyboard, it appeared on the display screen, with somewhat the same style that a teletype machine would print on paper. In fact, these display devices are actually usable as replacements for teletypes, but they are quieter and faster by far than a teletype.



Dave Ehnebuske at the CRT terminal.



Wade Davis at the console typewriter of the IBM 360/50 computer.

Most teletypes are used to send messages from one person to another person, and the message probably would be understandable to you if you glanced at it. If, for instance, you are standing beside the receptionist in Charlottesville or in the laboratory building lobby in Green Bank when the teletype starts banging away, you can see that the message coming out of the teletype is being sent by a human being--probably from hundreds of miles away.

However, NRAO also uses teletypes to communicate with computers. Cryptic indeed are the messages which then are sent--sometimes only a few numbers--although to the eye of the initiated user such messages have profound meaning. Sometimes the letters and numbers we type in are telling the computer what to do next. Occasionally the message which the computer sends to our teletype tells us that all is not going well.

At Green Bank there are three computers, and at Kitt Peak another one, which can "talk" to us in this way. They are smallish computers which help the telescope operators and the scientific observers to point the telescopes, and to record the data that comes from the telescopes. At Charlottesville the

Continued, next page--

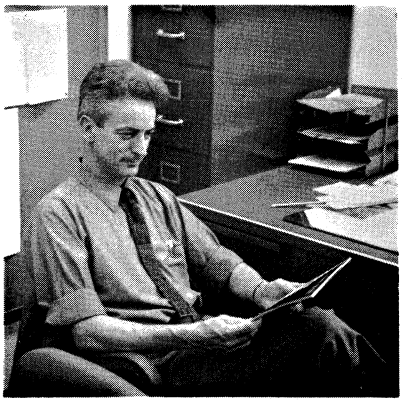
big IBM computer, which does the final digesting of most of our radio astronomy data, can likewise give or receive messages thru such a device--in this case, an IBM Selectric typewriter, of course!

These computer-connected typewriters and teletypes are called "user terminals," and sometimes "interactive user terminals" if the computer is so arranged that it can carry on somewhat of a dialog with you; and the new television-like versions, which I started to tell you about, are called "CRT (Cathode Ray Tube) user terminals." At Charlottesville we intend to connect several of these to the big IBM computer. We hope to modify the computer's internal coding so that it "knows how" to carry on a dialog--in fact, several dialogs simultaneously with several astronomers.

You may find it perplexing (some would even say disturbing) that we claim that a computer "knows how" to do this; or the computer "thinks" that; or the computer "understands" something else. Of course, this is sheer anthropomorphism--as when a sailor refers to a ship as "she"--for, when we work long hours with an inanimate device that can react in complicated ways, we seem to endow it with a bit of our own personality, be it boat or computer. Perhaps, we even ascribe to it certain obstinate attributes and disavow the "mistakes" it makes by alleging that it possesses someone else's personality.

If you have glimpsed one of our computers from afar, but haven't been allowed to try your hand at controlling it, you may think of it as a box with twinkling lights and adjacent machinery which occasionally spins and whirs. It may seem a mystery how one controls this electronic beast via coding--or even, how one knows what it is doing at all, when you have heard that it performs its stepwise instructions ten-thousand or one-hundred-thousand per second and even faster.

Never mind the flashing lights and the whirring magnetic tapes, the clacking printer, the reams of paper pouring thru the machine. What does it look like in our mind's eye, to those of us who have been initiated into its mysteries? Would it surprise you to learn that a computer is extremely stupid?...that it does nothing at all unless the programmer "tells" it what to do?...that if your program tells it to do something wrong it will go on doing that wrong thing over and over without ever learning the difference?



George Conant

What is a "computer program?" It is a sequential list of simple instructions. A long enough, complicated enough list of instructions may produce a very beautiful, useful, finished result. Suppose we could attach, not a radio telescope, but some motors for manipulating knitting needles, yarn, etc. to one of our Green Bank computers. Suppose that the list of instructions (normally in computer-code numbers) had the plain English meanings of:

```
knit 10
slip 1
knit 10
purl 1
knit 1*
(etc.)
(etc.)
knit 5
repeat from *
```

You ladies know how tedious it would be to write out all of the stepwise instructions that exactly describe every move you go thru in knitting a sweater. The complete list of many thousands of repetitions of the same steps would be too tedious to read. "Too complicated to comprehend," people would say who had never been introduced to knitting.

Continued, next page--

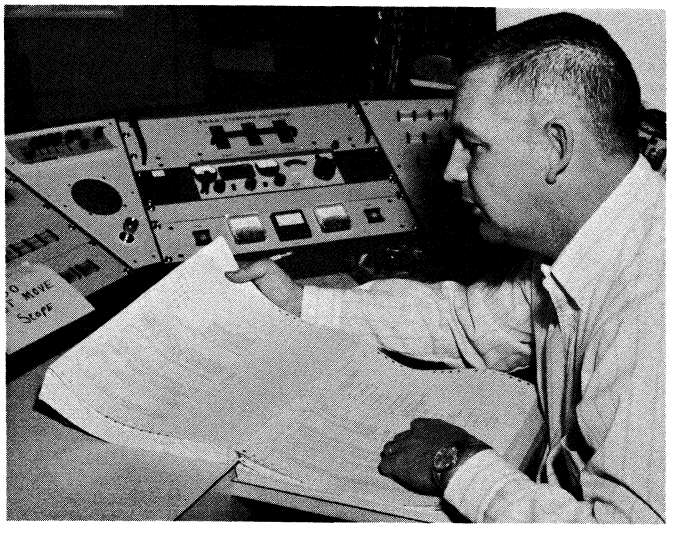
Yet the end product--a beautiful sweater or shawl--can be comprehended as a whole, as a patterned structure, and as a thing of utility and beauty.

Well, let's face it. Such a set of steps is tedious and complicated. We would call the whole thing a computer program and the individual verbs, "knit," "slip," and "purl," would be the individual operations that the computer could perform. Of course, our particular computers don't understand that kind of operation instruction code. Rather, they are designed to work with numbers and so they understand instead such instructions as:

COPY the number from location X
ADD the number from location Y
STORE the result in location Z

Locations X, Y, and Z might be the boxes in which you write the dollars on your income tax form. The stepwise instructions which you follow as you make out that income tax report are like a computer program. (Now, you are acting the role of the computer!)

Yes! Such a set of steps is tedious and complicated! Even more tedious is the job of figuring out how to make out the instructions in the first place, so that there is no ambiguity nor contradiction, and so that every step is there and the answers come out correctly. To accomplish this, computer programmers need a lot of patience and a lot of perseverance.



Bob Vance looks over a computer program listing.

Well, who among you can think of other processes which are very complicated yet so fascinating that you don't think of the tedium involved?...a game of chess? Probably anyone with the patience to master chess would also have the patience for programming. In fact, a computer program which chases down all the moves and calculates the necessary strategies for an automatic game of chess would be one of the most complicated programs ever devised. There are very few in existence. If you read descriptions of such a chess-playing program in action, almost certainly you find that the computer was never rigged up to move the chess pieces itself via motors, like our hypothetical sweater-knitting computer. It is easier to program the computer so that it merely types out the chess codes for the moves; then a human moves the pieces on the chess board. Thus enters, once more, that ubiquitous device: the user terminal. It sends you messages although you sometimes have to think awhile before you type in the answer.

In some cases, a chess-playing computer is a small computer; it can idly sit and wait for your answer. Our big computer is too expensive to be kept waiting when it could be doing other things. Therefore, while you are deciding what to answer, the computer may go about doing several other jobs, involving about a million additions and multiplications each, and also send messages to (or receive answers from) about ten other user terminals. The users, we hope, will be happy astronomers.

Please, don't tell those hard-working "astronomers" at the other CRT terminals that you are playing games at your terminal. Tell them (if they ask) that you are doing Poisson statistics on a crab-like SNR in Pisces; they will never guess that something fishy is going on.

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A HOME REFERENCE LIBRARY FOR $20.... OR WHO NEEDS ENCYCLOPEDIA BRITANNICA

Virginia van Brunt

Have you been wanting to update your home reference collection? Looking for a useful gift you know your children can use (and you know better than to buy clothes), and you don't want to invest several hundred dollars in a home encyclopedia. Perhaps a paperback reference library is the answer. The selections below are taken from a list of 21 paperbacks suggested for a home reference library for high school students and adults.

A CHRONOLOGICAL ENCYCLOPEDIA OF AMERICAN HISTORY by Irving S. Kull and Nell M. Kull, new enlarged edition (640 p., Popular Library, 1969, $1.45).

Covers events through Jan. 1969, has a chronological arrangement, and is useful for determining the date on which some event occurred or for giving a picture of a year or an era.

COLUMBIA-VIKING DESK ENCYCLOPEDIA (2,016 p., Dell, 1964, $2.25).

Articles are brief, but provide quick information.

DICTIONARY OF SCIENCE by Siegfried Mandel (407 p., Dell, 1969, $1.25).

Covers science from "abacus to zymology". This is especially useful for the general science student.

DOCUMENTS OF AMERICAN HISTORY, 8th edition, edited by H. S. Commager (2 vols., Appleton, 1968, $4.95 each).

A valuable pair of books for American History students of all ages.

THE ELEMENTS OF STYLE by William Strunk, Jr. and E. B. White (71 p., Macmillan, 1959, $.95).

Basic rules of usage, such as how to form plurals and what to do with parenthetical expressions.

THE GREAT QUOTATIONS compiled by George Seldes (1,086 p., Pocket Books, 1960, $1.25).

From "abolition" to "youth", the subjects in this collection seem particularly apt for today's user.

A HANDBOOK TO LITERATURE by W. F. Thrall and Addison Hibbard, revised and enlarged by C. H. Holman (594 p., Odyssey Press, 1960, $2.75).

The most complete handbook of literary terms available in paperback.

THE NEW AMERICAN ROGET'S COLLEGE THESAURUS IN DICTIONARY FORM (414 p., New American Library, 1962, $.60).

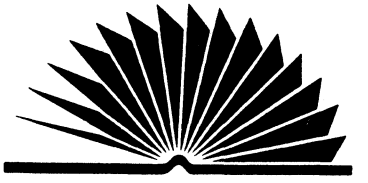
An important aid to students for composition and other written work.

PUTNAM'S CONCISE MYTHOLOGICAL DICTIONARY by Joseph Kaster (180 p., Capricorn, 1964, $1.65).

Quick and easy identification of characters in mythology and sacred books in a dictionary arrangement.

WRITING THE RESEARCH AND TERM PAPER by Travis L. Hauser and Lee Learner Gray (92 p., Cambridge Book Co., 1964, $.75).

Includes everything the student needs to know about planning, outlining, writing, organizing and revising a research paper.



Another word on colloquia tapes.... In Charlottesville we are receiving IEEE Soundings. To date we have received two:

SYSTEMS ENGINEERING: ART, SCIENCE AND POLITICS

ELECTRONICS IN COMMERCIAL AVIATION

If you are interested in borrowing either or both of these, call the library. Machines are available in both libraries.

During National Library Week, we hope you got to the library to see the posters, to take advantage of a few free reads, and to get a book marker -- to remind you we are open year round, 24 hours a day ... Get it at the library.

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VISITOR-USERS OF NRAO TELESCOPES DURING 1970

Bill Howard

During each springtime over the past few years the NRAO has summarized for the National Science Foundation the use of its facilities by both its visitors and its resident scientific staff. I would like to summarize part of this material here. Perhaps all of us are not fully aware of the tremendous increase in visitors that the Observatory has experienced during the last few years and I would like to take this opportunity to highlight some of the most interesting aspects of this growth, as well as to point out some areas of research where the NRAO has had an impact on the national and international scene.

Perhaps the two most startling statistics that I can come up with are that during the month of February 1971, which was a short month at that, there were more visitors associated with observing programs on NRAO telescopes than were associated with programs throughout the entire calendar year of 1966. Moreover, 1/4 of the 222 different observers who have used NRAO telescopes since July 1968 were observers during the single month of March 1971.

During 1970 there were 25 permanent staff members and 14 research associates engaged in research at NRAO. The number of visitors engaged in research here totaled 135. Of these, 36 were students. These 135 visitors came from 40 different institutions and 11 of those 40 institutions were located in foreign countries.

Table 1 shows a breakdown for each telescope, listing the number of visitor-users, the number of students, the number of research associates and permanent staff members, as well as the number of institutions from which the visitors and students came. Even though these statistics look impressive, only those for the 140-ft. telescope are truly representative of normal operation. For example, the 300-ft. telescope was down during the months of June-November for the installation of its new surface. The interferometer was down during the months of April and May while the new 3 cm receiver was being installed and the 36-ft. telescope was down for most of the months of July and August for maintenance and normal summer shutdown. This year, 1971, promises to be much more "normal" since we do not anticipate any long-term shutdowns on any of the telescopes.

As these statistics show, 1/4 of our visitor-users are students. About half of them are working on observations that will contribute directly to their doctoral dissertations while the other half are assisting their university advisors on observing programs. Since the beginning of 1967, 19 students have received their doctor's degrees on material where the major work was done at NRAO. I estimate that in 1971 alone there will be 14 students who receive their doctor's degrees based on work done here.

Although we do not keep rigid track of the fields of radio astronomy in which visitors and staff publish the results of their observations, it is interesting to note that in the bibliographical summary of the International Astronomical Union Commission 40 (Radio Astronomy) draft reports, 11% of all the papers cited were produced at NRAO. Forty-eight per cent of all the papers came from the United States. If this crude statistic can be trusted, about 1/4 of all papers produced in the United States on radio astronomy resulted from observations made at NRAO. Without doubt, the NRAO is a world leader in papers having to do with line radiation in the galaxy. Of the total number of papers cited, 24% originated from observations done at NRAO having to do with this subject. One paper out of every 6 that was published in cosmology and extragalactic radio astronomy resulted from NRAO observations. About 6% of the total number of papers cited had to do with each of two areas, pulsars and continuum radiation from the galaxy. In January of this year Gerrit Verschuur searched the Astrophysical Journal, Astronomical Journal, Astrophysical Letters, and Astronomy and Astrophysics and found that 70% of all the papers published on radio observations made at observatories within the United States were produced by NRAO visitors and staff. We only passed the 50% mark in 1969 and the 30% mark in 1967--things are really mushrooming!

When one reflects on the fact that we have not added a major new telescope system

at NRAO since 1968, it is natural to ask, "Why are we experiencing such an observer explosion?" I think the answer lies in the advances that have been made in the receivers and computer systems. The interferometer now observes at two frequencies simultaneously, the 300-ft. telescope is equipped with 3-feed and 4-feed systems, the noise temperatures of receivers are going down, particularly at high frequencies, and more and more sophisticated computer programs are being developed that will produce good results in shorter periods of time. Moreover, there has been a noticeable tendency for two or more observers to collaborate on an observing program where in the past one observer alone would be running the program. Part of this tendency to team up is due to the pressure on observing time at the telescopes and part is also due to the increased complexity of observing. I think all of us must take our hats off to the engineering division for their design work, to the electronics division for better and more sophisticated receiver systems, and to the computer division for their more sophisticated techniques of data handling.

TABLE 1

Telescope Usage for 1970

	140 foot	36 foot	Interferometer	300 foot
No. Visitors	66	32	11	15
No. Students	26	8	3	4
Subtotal	92	40	14	19
No. Research Associates	4	2	8	3
No. Permanent Staff	11	7	12	4
Total	107	49	34	26
No. Institutions	32	20	8	9

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GREEN ARBOR GARDEN CLUB

Kay Williams

The Green Arbor Garden Club was signally honored at the 41st annual meeting of the West Virginia Garden Club, Inc., held at The Greenbrier Hotel at White Sulphur Springs on March 29th and 30th.

The annual awards banquet was held the evening of March 30, this year. Two of our members attended with little expectation that we would be cited for any awards. Much to our surprise and delight, we were cited for two awards: The first was the West Virginia Department of Highways, Roadside Park Section Plaque given to our Club for the most outstanding roadside beautification project. This plaque remains permanently in the Club's possession. Our second citation was the West Virginia Garden Club Award for 1970, a silver tray. This is the highest award a club can receive. It is a rotating trophy, awarded annually and held by the club for a one year period. We were the first club in the state to be presented this trophy in the first year of it's being federated. This award is given annually to the club meaning the most to its community.

Our efforts included extensive plantings at the Observatory, plantings at the school, community clean-up activities, our roadside mini-park planting, and for active participation in protesting the pollution of Cheat River, through letters to our State's Congressmen and our State Department of Natural Resources. Our club members were ably assisted in our activities by the Boy and Girl Scouts, the PTA, the 4-H Club, and NRAO.

As retiring president of the club, the memory of these awards will be a great joy and satisfaction to me personally, and I wish to express my sincere appreciation to all our members and friends who worked so hard and made it all possible.

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NEW 300-FT. CONTROL ROOM

T. Williams

Modifications and improvements to the 300' telescope installation continue. A new surface, a new drive package, a new travelling front end mount, and now a new operating console room.

The existing control room has been crowded (with a capital C) for several years; to the operators and visitors, relief is in sight.

The new control room is to be provided in the form of an addition to the south of the existing building. Between the two will be a small section providing a ground level entrance with a short flight of stairs leading up to the operating level and another leading down to the half submerged basement or lower floor. The new floors will match the levels of the existing building.

The new addition, exclusive of the entrance and stairwell, is to be approximately 32 feet square with the upper level being used solely for the new control room. The "racks" will be located in the form of a hollow square providing an operating and console area 18 feet x 18 feet within the square. This will provide adequate space behind the racks for servicing. The ceiling will be somewhat higher than the existing control room ceiling, eliminating the feeling that the ceiling is literally on your head.

Approximately half of the lower floor area will be required to house the mechanical equipment -- heating, ventilation, and air conditioning.

The existing control room area is ultimately planned to provide a visiting scientist office, a chief operator's office and an "electronics" works area.

The addition has been designed by the Architectural firm of Stainback and Scribner of Charlottesville, who were associate architects on our Charlottesville building.

Bids for the construction have been received and the awarding of the contract is imminent. It is hopeful that the construction may be completed by the 1st of August.

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36-FOOT NEWS

Bob Hogarth

On New Year's Eve NRAO-Tucson employees ventured out into 45 degree temperatures and an accumulation of four feet of sunshine to attend a combination open-house and New Year's Eve party at Dewey and Kay Ross' new home.

The land of sunshine and warm weather has acquired another employee -- Neil Albaugh transferred from Charlottesville. Dewey is making good use of Neil's many talents.

On the technical side, Penzias, Wilson, and Jefferts of Bell Labs and Solomon of Columbia, working at 147 GHz, have detected carbon monosulfide (CS), first in an IR star and later in the usual H II regions. This was the first detection of sulfur, so instead of the traditional champagne party for the operators, they thought a subscription to "Playboy" would be more in order. It was heartily seconded.

The solar observers from Aerospace (Mayfield, Shimabukuro and Edelson) weren't so lucky; for their two week stint on the 'scope the sun was the quietest in four years.

Also doing some solar work was Dr. Gerhard Feix, from the University of Bochum, West Germany.

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HEESCHEN ELECTED TO ACADEMY

On April 27 the National Academy of Science announced the election of Dr. David S. Heeschen to the Academy. Dr. Heeschen, who is noted for his studies of extragalactic radio sources and his early work on hydrogen in the Milky Way, is only the second radio astronomer thus honored.

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NEW INTERFEROMETER STATIONS

John N. Ralston

In November, 1969, a development program for "The NRAO Interferometer" was printed and distributed. In this program many projects were included to upgrade the present NRAO array which would, in turn, progressively improve the interferometer as an instrument.

The planned expansion of the NRAO array is summarized in three major projects:

(1) Add two observing stations at 2033 meters and 2066 meters,

(2) Add a fourth 85-ft. antenna with complementary short base line, and

(3) Add a complementary base line with three 13 meter antennas.

For spectral-line work each project would progressively improve the present NRAO array by allowing shorter base line observations that are desirable for spectral line work; allowing a compact configuration of the existing antennas for improved spectral work (with addition of fourth 85-ft. telescope); allowing a compact triangular configuration (with a fourth 85-ft. telescope on a complementary short base line) which would be superior to a line array.

Part of the expansion program will become a reality this coming summer with the addition of two observing stations, 20 1/3 and 20 2/3, on the existing base line.

NRAO Engineering Department has compiled a bid package for the construction of the two new stations, revision to station 2100 meters, and roadway revisions.

Bids will be received by the end of April and a contract will be let for construction to start by May 3, 1971, with a tentative schedule for work to be completed by the latter part of August, 1971.

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SAFETY

John W. Hawkins

On Tuesday, April 6, at 11:55 a.m., in just 30 seconds I became a lost-time statistic. Yes, it happened that fast--I too felt that it "couldn't happen to me"--but it did. I was fortunate, if the victim of an accident can be considered fortunate. I slipped and fell, heard my ankle "crunch", and immediately felt the excruciating pain that accompanies sprains and pulled ligaments. We now have a doctor in Green Bank and this made it possible to obtain pain-relieving medication, and have diagnostic x-rays taken within minutes of the accident, rather than having to make a long painful trip to either Marlinton or Elkins, as would have been necessary before Dr. Aga took up residence here.

Yes, I was lucky! My injuries could have been much worse, and the interval between the accident and medical attention could have been long and painful; but thanks to the efforts of the management of NRAO we now have a doctor available to take care of emergencies as they may arise.

Although medical attention is now available, we still need to be careful--accidents can and will happen--they happen fast--when we least expect them. YES--IT CAN HAPPEN TO YOU. In 30 seconds you too can become a lost-time statistic. Yes, you could be permanently disabled or killed. Watch for hazards and unsafe practices, think--be careful --you may be the next lost-time statistic.

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SITUATIONS WANTED

BABY SITTING WORK----Mary Jane Oref, age 13. Weekends until school is out. Anytime after June 8 when school is out. Where? Home, pool, and recreation area. Rates: $.50 per hour until midnight. $.75 after midnight. TELEPHONE: 456-4647

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RUMFORD AWARD

America's oldest scientific prize, the Rumford Premium, was awarded April 14 by the American Academy of Arts and Sciences to three teams of scientists for their pioneering work in long-baseline interferometry, a new technique which enables astronomers to determine the structure of quasars and other sources in outer space.

Medals were presented at a meeting of the Academy in Boston, Massachusetts, by Professor Edward Purcell, Nobel Prize-winning physicist from Harvard University, and Professor Talcott Parsons, sociologist from Harvard and President of the Academy, to representatives of the three groups: one from Cornell University and the National Radio Astronomy Observatory, another from MIT and a third from several institutions in Canada. The members of the three groups cited by the Rumford Committee were:

NRAO-Cornell Group

Claude C. Bare*
Barry G. Clark
Marshall H. Cohen
David L. Jauncey
Kenneth I. Kellermann

M.I.T. Group

John A. Ball
Alan H. Barrett
Bernard F. Burke
Joseph C. Carter**
Patricia P. Crowther
James M. Moran, Jr.
Alan E. E. Rogers

Canadian Group

Norman W. Broten
R. M. Chisholm*
John A. Galt
Herbert P. Gush
Thomas H. Legg
Jack L. Locke
Charles W. McLeish

Canadian Group (cont.)

Rogers S. Richards
Jui Lin Yen

* Deceased
** Former Co-op at Green Bank, and a native of Huntington, W. Va.

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FACTS FROM FISCAL

"Check Your Federal Withholding Tax"

Many taxpayers are likely to have too little withheld from their paychecks this year, says the Internal Revenue Service. For example, the top withholding rates are limited to 24% for single persons and 25% for married persons; however, the actual tax rates can be much higher. Also, the withholding rates are based on the new 13% standard deduction, but do not consider the fact that there is a $1500.00 ceiling on this deduction for 1971.

The following classifications of taxpayers are likely to be affected:

1. All working couples.
2. Other married employees who expect to earn $25,000.00 or more.
3. Single employees who expect to earn more than $15,000.00.
4. Employees who expect to earn more than $11,500.00 and intend to claim the standard deduction or itemized deductions totaling less than 13% of their salaries.

The Fiscal Division has the new income tax tables and rates for 1971 and you are welcome to use them. They are different from the 1970 rates.

If you find that you should have more Federal Tax withheld, please contact us and we will be happy to assist you in any way we can.

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PERSONNEL

New Employees

Dr. Hugh S. Murdoch	Temporary	Basic Research
Janice S. Marks	Part-time	Tucson

Returning Employees

Alan D. Ezer	Co-op	Scientific Services

Terminations

Gladys A. Vance	Part-time	Admin. Services
Josef Maslowski	Permanent	Basic Research
Claude N. Williams	Co-op	Scientific Services
C. Keith Sword	Co-op	Scientific Services
Daniel J. Vitiello	Permanent	Computer Division

* * * *

OBSERVATORY TOURS

The 1971 tour season will start on June 12 and end on October 31. Daily tours will be given from June 12 until September 7 and weekend tours from September 11 until October 31. Tours will be given from 9:30 a.m. until 5:00 p.m.

From June 12 to August 24, tours will start from the Green Bank Grade School. After August 24, they will start from the Observatory warehouse auditorium.

The tour program will include a 15-minute movie on radio astronomy, a guided bus tour of the site and telescopes, and a demonstration of how a radio telescope works.

Tours will start every half hour and take about one hour. Tours are free.

****

INTERSTELLAR FORMAMIDE

R. H. Rubin and G. W. Swenson, Jr., Astronomy Department, and R. C. Benson, H. L. Tigelaar and W. H. Flygare, Chemistry Department, University of Illinois, report:

"Formamide (NH_2COH) was detected on March 23 at a wavelength of approximately 6 cm in the direction of Sgr A and Sgr B2. The 42.7 m (140-ft) telescope of the National Radio Astronomy Observatory was used. Formamide is the simplest molecule containing the amide linkage and hence is of interest from the viewpoint of prebiological chemistry; and it is the first molecule found in the interstellar medium that contains atoms of H, C, N, and O."

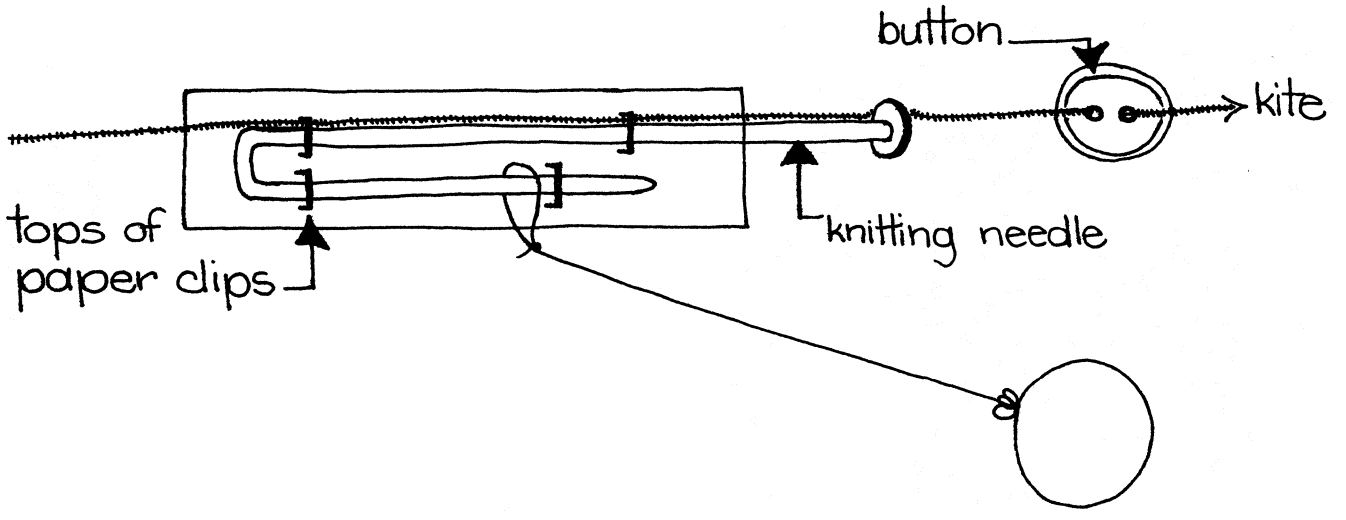
****

KITE FLYING

Butler Burton

Here are some variations to try the next time you "go fly a kite". The drawing shows a gadget that can be used to launch balloons, parachutes, gliders, or other things from the kite. The nice thing about it is that the kite does not have to be brought back between launchings. The gadget is made from an aluminum knitting needle, some paper clips and a piece of sheet metal or sheet plastic. The drawing is life-size, except for the balloon. The balloon or whatever is tied to a two-foot long length of string which has a loop on the free end which fits on the launcher. The wind carries the balloon, dragging the launcher, up the kite string towards the kite. A big button is tied on the kite string about five feet from the kite. The knitting needle part of the launcher will strike the button and slide back down the string. If the kite string is free of knots, the launcher will come back so fast you have to watch that your finger is not cut.

Any sort of kite can be used for launching things. A good long string always helps since it gets the kite up into stable air. Low-flying clouds are generally lower than you think and it is not too hard to get a kite up into them. I have helped fly kites that were so big that 3/4-inch rope was used to hold them down. But it isn't easy to build or to fly such monsters. It works much better, if you want lots of lifting power, to fly several kites in tandem. Any number of normal kites can be used. Each kite is attached to the main string by a piece of string about 50 feet long. Kites are separated by about 100 feet. After two kites are launched, it is very easy to launch all the rest of them. The main string has to be pretty thick after a few kites are in the air.



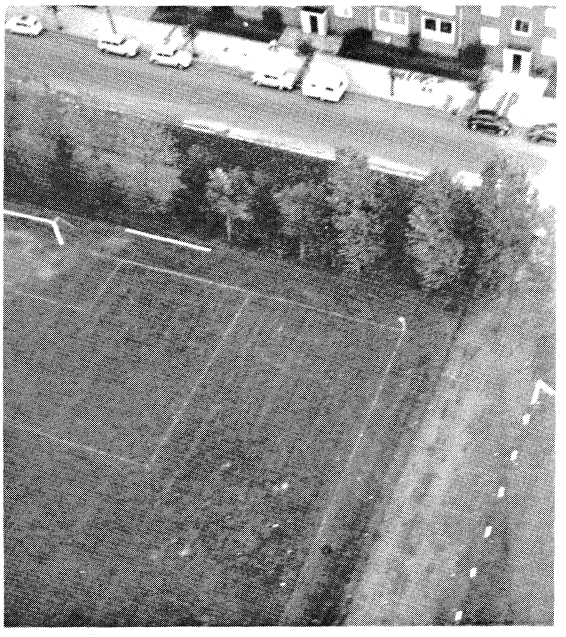
Burton's "gadget" for launching parachutes, gliders, and what-have-you from a high-flying kite.

One of my kites is fairly big, about one yard square, and I have used it as a picture-taking platform. The camera I used was a Five-and-Ten-Cent store toy, just in case of trouble. The camera was attached to a wire frame. This frame was tied to the kite string about 100 feet from the kite. Putting it so far from the kite is important for two reasons. In the first place, the string is much more stable and

Continued, next page--

KITE FLYING (cont.)

quiet than the kite itself. In the second place, the kite does not have to be brought completely down while the film is advanced. When the film has to be advanced, the free end of the kite string can be tied to a tree. Then you can walk hand-over-hand along the string until the camera is reached, with the kite still in the air. When the film is advanced, just let go of the camera and it will climb right back up to a good height. The shutter of most toy cameras is tripped by a lever. I used a little kitchen timer tied to the camera, with a string running from the shutter level to the windup knob of the timer's alarm, to set the camera off. The picture below is the only example I could find at home.



I have never flown them, but a friend of mine flies hot-air balloons. He makes them out of model-airplane paper and balsa wood strips and flies them on windless days. They are about two feet in diameter. He fills them with hot air from a charcoal fire using a sort of upside-down funnel. They go out of sight.

Kites can be flown out of sight, too. This is fun, but it requires a cheap, disposable kite, and an ocean, or a big lake, with an off-shore breeze. After the kite is launched, the end of the string is tied to a piece of driftwood. The wood has to float and has to be quite heavy. If you put the wood in the water, the kite will drag it along. If the wood is pretty heavy, it goes slowly enough so that the kite stays in the air. Then you can sit back and watch the kite disappear out to sea.

****

SCOUT'S RAFT RACE

One of the two-boy teams competing in the first lashed-log race ever held on Deer Creek. On April 25, the Webelos (age 10) rafted to victory over dens 1 and 2 (ages 8 and 9). Raft turned upside down because of low water conditions.

****

NRAORA

Buck Peery

Your Recreation Association has been quietly carrying on those functions which could be executed during the fall-winter season and has been making plans for the spring-summer season.

Our Valentine's Day Dance was not as well attended as had been hoped for, but highly enjoyed by those attending. The board could not come up with one good reason why the attendance was low. It appears there might have been a number of reasons. The board felt that the small turnout for the Valentine's Day Dance would probably experience the same results and, therefore, did not schedule a Spring Dance. The "New Year's dance is scheduled for Friday, December 31, 1971 -- NEW YEAR'S EVE! The "Esquires" have been contracted for the dance. Start making your plans to attend.

The Green Bank bowling teams are having a very active and enjoyable season. Their season ends the last week in May. A match between a Charlottesville team and a Green Bank team was rolled on April 24. The roll-off occurred in Staunton, Virginia, on neutral ground. Bob Eskanazy reports on this bowling match in another article.

The basketball team has been active and will close out their season with a party late in April. A very energetic and interested group participated and the season was enjoyed by all.

Plans are progressing for spring and summer softball. The back stops will be completed and the field graded in the near future. New equipment has been ordered.

Improvements in the rifle range are being started. It is hoped they will be completed during the summer months.

Mr. Robertson will be at the "Rec" area on week-ends to issue equipment, etc. from now until the summer season opens.

Efforts are being made to open the pool room in the Residence Hall. A study is being made to determine what is needed to repair the equipment and an effective way of controlling the use of the area.

Our annual meeting of the general membership will be Tuesday, May 18, 1971. All members are invited to attend and bring their suggestions.

The nominating committee is busy looking for board members for the coming year. If there is anyone who would like to serve, or has someone they would like to see serve, please contact the nominating committee or a board member. Any employee with ten months service is eligible to serve on the board of directors.

****

INDOOR TOMATOES

W. Oref
(The Old Dirt Dobber)

This winter I was engaged in a rather unusual experiment carried out in the Jansky Lab. While my experiment was only one of many hairy experiments pulled off in this lab, it was unusual because the fruits of my experiment were quite visible and anyone could sink his teeth into the results. This winter I successfully raised a tomato plant which produced about one dozen red, ripe tomatoes.

There was nothing elaborate about my experiment. I simply planted a few tomato seeds in a five gallon bucket and sat back and watched a tomato seed mature into a bearing tomato plant. --Well now, I did do a little more than I said. I planted the right seed, I used good soil, I provided adequate drainage, and I pollinated by hand. I planted a special tomato seed for indoor culture called "Spartan Red" purchased from the Burgess Seed Company. (Many varieties of indoor tomatoes are available). Spartan Red, as well as other greenhouse varieties, will set and develop fruit in the winter when days are short. Ordinary tomatoes we plant in summer will not set fruit during the winter months. Until a few years ago,

Continued, next page--

I wasn't aware of this difference.

The garden soil I used was made up of equal parts of garden loam, peat moss, and sand. My growing medium was sterilized this way: I put the mixture in a metal wheelbarrow, and built an oak fire over it. I cooked the soil for about four hours. Of course, the top of the fire wasn't wasted either. While the soil was cooking, I roasted hotdogs and drank beer. One should plan these multiple use projects very carefully.

Drainage was provided by holes in the bottom of the bucket and 3/4 inch of gravel. I made about a dozen holes in the bottom of the bucket with a cold chisel. Before I put the soil into the bucket, I placed 3/4 inch of gravel over the bottom. The holes and gravel provide drainage for excess water and prevent water build-up in the soil.

When an indoor tomato plant begins to blossom, it requires special attention. The blossoms have to be pollinated by hand. Otherwise, no tomatoes will form. Outdoors this is done by the wind and insects. These agents aren't available indoors and you have to do it.

Fortunately, it is a simple process. All you have to do is tap the stem below the flower cluster several times, two or three times a day during full bloom. Full bloom generally last about six to seven days. How much fruit sets depends upon how well you pollinate. If no tiny green tomatoes show a few days after the flowers wither, it means that good pollination was not achieved. Once tiny, green tomatoes appear, the rest of the time is spent answering questions and watching the tomatoes ripen.

Because my office was so hot and dry, and because the plant required a lot of water for normal growth, I had to water religiously every other day. Several times when I missed watering on weekends, I found the plant badly wilted when I came to work on Mondays. Fortunately, one good watering revived the plant. I watered with Schultz plant food mixed in water. A bottle of this plant food costs sixty cents at Murphy's five and ten. It goes a long way because it is in a concentrated form. Once I got into the watering habit, it was not much of a chore. To prevent washing away the top soil, I covered it with a 1/3 inch of gravel.

Old Dirt Dobber with his Spartan Red tomato plant.

How do indoor tomatoes taste? I've found that vine ripened indoor tomatoes taste as good as the ones grown outdoors. This leads me to suspect that greenhouse tomatoes are picked and shipped before they are ripe, and full flavor is never developed.

Why not try raising tomatoes indoors for Christmas? You can do this if you start your plant outside in August. Plant the seed in the same container you will use indoors. By the time frost threatens and it is time to bring the plant inside, it should have many green tomatoes on it.

If you are interested in trying your hand at raising an indoor tomato, I have a few extra seeds that I am willing to part with.

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TRACKING FEED MOUNT FOR THE 300-FOOT TELESCOPE

Bill Brundage

A basic limitation on the astronomical use of the 300-ft telescope is that it is a transit instrument. "Transit" is technical jargon meaning the telescope is movable only in a north-south plane along the meridian. Thus, it relies on the earth's rotation to "move" the sky and radio sources from east to west through its field of view. Consequently, each radio source is visible to the 300-ft for only a few minutes or even seconds once each day.

For those numerous astronomical measurements requiring a long "look" at a radio source, the astronomer must observe the same source repeatedly on successive days and then combine the separated data. With a fully steerable telescope such as the 140-ft and interferometer, he can track any source for many hours.

Observations which typically require long looks at a source are pulsar, spectral line and polarization measurements. Generally, astronomers want to track a pulsar for long periods of time in order to average together a long sequence of weak pulses or to study pulse-to-pulse variations. For measurements of polarization, he needs time to observe the source with the feed-front-end-box at several rotational positions. Spectral lines that measure various atoms, ions and molecules and their interstellar environment, frequently require very long periods of tracking to beat down the receiver noise and build up the weak signals.

So, it would be useful to make the 300-ft telescope with its large collecting area into a steerable dish, albeit somewhat limited steerability. In fact, that was done for low frequencies below 500 MHz with the traveling feed. (See Observer, Vol. 9, No. 2, Nov. 1969). It has been used extensively for observing pulsars with tracking times up to an hour when looking at the celestial equator, and more than an hour at more southern and more northern elevations.

This worked so well that astronomers asked for a similar device to work throughout the higher frequency range. Thus the tracking feed mount was designed by the NRAO Engineering Division, fabricated by Sterling-Detroit Company (hence its common name of "Sterling Mount"), additions made by Central Shops, and installed on the 300-ft by the telescope mechanics and shop personnel. Electronic control hardware, i.e. wires, relays, and integrated circuits, was designed and assembled by Electronics Division and Telescope Operations personnel. Computer control software, i.e. the computer program contained in tens of thousands of tiny rectangular holes in hundreds of IBM cards, is by the Computer Division - subdivision of Greenhalgh and Vance.

The tracking mount has three basic functions. The first is to move a front-end box containing receiver(s) and feed horn(s) along a precise east-west line called the hour angle motion. This movement makes the telescope "steerable" by allowing it to track a radio source through a narrow "window" as the earth's rotation "sweeps the sky" from east to west across the telescope's meridian. It is a property of reflector type antennas that if the feed, which collects the power reflected from the dish, is moved laterally away from the focal point, say to the west, then the telescope "sees" a point on the sky which is east of the point it sees when at the focal point.

Thus, it seems we could "point" the telescope at any point in the sky simply by tilting the entire dish along the north-south meridian as it was built to do and also moving the feed to the east or west as required. However, physical laws are such that we don't get this steerability for nothing. We pay several penalties. As we move the feed further away from the focal point, we lose efficiency. The antenna efficiency decreases as the feed moves out, falling by 20 percent at 2 1/2 wavelengths out from the focal point, and falls very rapidly further out. Secondly, as the feed moves out, its "seeing" becomes distorted astigmatically. Thirdly, it begins to see a spurious second area of sky. This response is called the coma lobe.

In spite of these penalties, a moving feed is very usable for most observations. At low frequencies around 100 MHz where wavelengths are as long as several feet, the entire

Continued, next page--

25 ft. offset of the traveling feed is usable --allowing an hour or more of tracking a source. At 500 MHz where the wavelength is 2 ft., only about half of the available traveling feed offset is usable. Then at 21 cm and shorter wavelengths (frequencies above 1300 MHz) the usable feed offset is 20 inches or less. This is why the tracking mount's offset limit of 15 inches (set by the size of our front-end boxes and the inner dimensions of the 300-ft feed support leg structure) is still very usable. At a wavelength of 21 cm a radio source can be observed for 4 minutes with the Sterling mount compared to 2/3 of a minute for a drift-through with the old fixed mount. For many measurements this is a substantial improvement.

The second basic function of the tracking mount is to rotate the front-end box. The old mount could not rotate at all. Rotation is necessary for many polarization measurements. Several front-end boxes contain multiple receivers and feeds. The configuration of these multiple feed responses on the sky can be changed by rotation.

The third basic function of the Sterling mount is to move the front-end box in and out from the dish along its focal axis. This is called focusing. The old mount provided only this motion. Focusing is very important for three reasons. All front-end boxes have a different distance between its mounting flange and feed phase center. The phase center must be placed precisely on the telescope's focal point for best efficiency. Secondly, spectral line observations often require moving the front-end box precisely one quarter wavelength closer to or further from the dish in order to cancel the effects of radiation reflections between feed and dish. Thirdly, the focus travel is sufficiently long to pull the box and feed into the focal house to allow the traveling feed to pass by when it is in use.

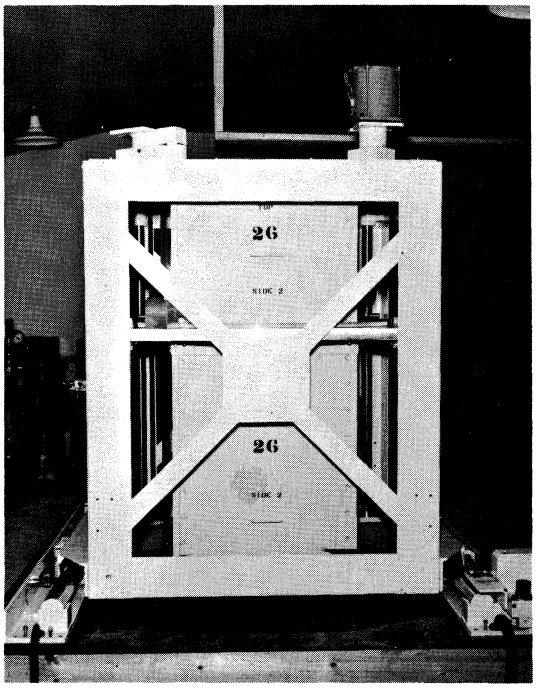
All three motions can be controlled manually by the telescope operator or controlled by the computer. If the astronomer prepares a deck of IBM cards, he and the operator can lean back in their chairs and shoot the bull while the computer does all the work! Well, some of the time maybe... provided there is room for a second chair among all the receiver racks in the control room.

The picture shows a side view of the Sterling mount minus a few appendages as it was on a ground based mock-up. Large support bars on which it glides in the east-west hour angle motion are visible in the lower right and left. Front-end box number 26 is mounted inside. Just below the upper "side 2" you can see the teeth on the large ring-gear which rotates the box. Barely visible just to the inside of the left and right vertical frame are the long screws which drive the box up and down for focusing. The focus drive motor is on the top right.

For the more technically minded, the range of mount movements are:

Hour angle	± 29.5 arc minutes
Rotation	± 200°
Focus	± 25 inches or
	± 635 millimeters.

By the time you read this, the tracking feed mount will be installed and operational on the 300 ft. Watch out 140', the 300' is about to deprive you of some of your exclusive observing programs!



Sterling Mount.

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AUI SCHOLARSHIP WINNERS

D. S. Heeschen has announced the following two winners of this year's AUI Trustee Scholarship:

Mr. David B. Horne

Mr. Horne has been active in the following clubs at Green Bank and Pocahontas High Schools:

Nature and Science Club	Sophomore and Junior
Chess Club	Freshman, Sophomore and Junior
Varsity Club	Freshman, Sophomore, Junior and Senior
Spanish Club	Junior
Honor Society	Junior and Senior
Interact	Senior

David is the son of Mr. and Mrs. William G. Horne of Green Bank, West Virginia. Mr. Horne is Head of the Engineering Division of the NRAO.

Mr. Steven M. Pasternak

Mr. Pasternak has been active in the following club at Albemarle High School:

Radio Club	Freshman

Commended Student in the National Merit Scholarship Examination.

Steven is the son of Mr. and Mrs. Bernard Pasternak of Crozet, Virginia. Mr. Pasternak is Technical Specialist in the Electronics Division of the NRAO.

Alternate winner selected by the Scholarship Committee is:

Miss Jetta Bowyer, daughter of Mr. and Mrs. Omar Bowyer of Green Bank, West Virginia. Mr. Bowyer is Head of Central Shops of the NRAO.

CONGRATULATIONS!

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1971 SUMMER STUDENTS

NAME	ASSIGNMENT	HOME TOWN	SCHOOL	RANK
Robert Boyle	Turner	Irvington-On-Hudson, New York	Princeton	U
David Burke	Tademaru	W. Lafayette, Indiana	Purdue	U
*Peter Camana	Weinreb	Pennsburg, Pa.	Lehigh University	U
*Kenneth Cantrell	Weimer	Quincy, Mass.	Western New England College	U
Bruce Carney	Nakano	Watertown, Mass.	Harvard	G
*Brian Dennison	Fomalont	Louisville, Ky.	Univ. of Louisville	G
**Linda Dressel	Rather	Cincinnati, Ohio	Univ. of Cincinnati	U
William Fawley	Gottesman	Glencoe, Illinois	Princeton	U
**Robert Freund	Conklin	Lancaster, Pa.	VPI & SU	U
Paul Giguere	Burton	N. Chelmsford, Mass.	Univ. of Virginia	G
Riccardo Giovanelli	Verschuur	Gattatico, Italy	Indiana University	G
*Mark Hartoog	Hogg	Carleton, Mich.	Univ. of Michigan	U
*Nelson Hoffman	Davis	Pennington, N. J.	Univ. of Wisconsin	G
David Koo	Manchester	New York, N. Y.	Cornell	U
Charles Lada	Wardle	Webster, Mass.	Boston University	U
Chun Leung	Hjellming	Berkeley, Calif.	UCLA, Berkeley	G
Linda Lucagnaui	Sramek	Santurce, Puerto Rico	Wellesley College	U
Robert McMillan	Wright	Cleveland Heights, Ohio	Case Western College	U
Robert Mutel	Clark	Boulder, Colorado	Univ. of Colorado	G
*Staffan Olson	Weinreb	Goteborg, Sweden	Chalmers Univ. of Technology	U
Barbara Smith	Verschuur & Turner	Richmond, Virginia	Johns Hopkins	G
Haywood Smith	von Hoerner	Charlottesville, Va.	Univ. of Virginia	G
Allan Spradling	Brown	Kalamazoo, Mich.	Univ. of Chicago	U
*Dennis Sweeney	Fleming	Lynchburg, Virginia	VPI	U
Santiago Tapia	Murdoch	Tucson, Arizona	Steward Observatory	G
Trinh Thuan	Brown	Saigon, S. Vietnam	Princeton	G
Dennis Ward	Buhl	Alberta, Canada	Cornell	G
Patrick Yeung	Sramek	Hong Kong, China	Princeton	U
Mark Zabek	De Young	Worchester, Mass.	Cornell	U

* Green Bank based ** Tucson based U - Undergraduate G - Graduate

SHOWDOWN
(or could Green Bank do it again?)

Robert Eskanazy

It was a moonless night when the Green Bank ten rode into town. Tension was high and the Charlottesville teams were waiting for the showdown to begin. The time had been set at 1930 hours; the place, Staunton Bowling Lanes.

The arrangements were made many weeks in advance by mutual agreement between Jackie Cochran and Don Hovatter. Their gangs consisted of twenty bowlers, each rearing to roll. Unfortunately, at the last minute, Jack Cochran was roped into changing his plans and could not participate in the action. Gloria Eskanazy, with great reluctance, agreed to fill in for Jack. The stage was set -- four five-man teams:

Green Bank	Charlottesville
K. Anderson	G. Eskanazy
D. Stone	B. Eskanazy
W. Monk	B. Pasternak
D. Hovatter	B. Brown
J. Spargo	G. Tademaru
R. Poling	G. Runion
B. Nichols	C. Pace
L. Webb	J. Davis
W. Vrable	B. Balick
W. Oref	B. Meredith

The action began and the night was filled with the sound of splattering pins. Three hours later we had our answer. The showdown was over and Green Bank once more had won. The score was Green Bank five games, Charlottesville three. Gene Runion and Robert Nichols led their boys to a standoff by winning two games each. It was a different story for the boys led by Bob Eskanazy. When the final tally was counted, Don Hovatter's Green Bank team had won three of the four games and had lost the second game by only one pin. It was a night filled with fun and excitement.

The pains of our losses were lessened almost immediately when the cry went out for beer and pizza. The word spread among the gang and the mass exodus was under way toward the Pizza Hut. I could only imagine what the management thought when we arrived and proceeded to rearrange their tables.

The evening came to a rapid end with many laughs and final goodbyes. Our only question, as yet unanswered, is when our next showdown will be (see Score Sheet on page 22).

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LABORATORY VENTILATION

Buck Peery

The crates, cartons, and material on the roof of the laboratory building do not indicate a new annex to the warehouse, or the beginning of a new storage area for the Site in Green Bank. These are fans, bases, and other components to be located on the roof for an exhaust and ventilating system which will cool and freshen the air on the second floor of the laboratory.

Air conditioning for the laboratory had been considered a number of times over the years, but installation problems, high costs, and its seasonal use, made it necessary to delay air conditioning each time it was considered. As an alternative to air conditioning, a ventilating and exhaust system for the second floor will be installed. While a ventilating system cannot equal an air conditioning system, it can help relieve some of the uncomfortable conditions by removing hot and stuffy air and by nearly equalizing the inside temperature with the outside air temperature.

Three, large, exhaust fans will be installed on the roof over the second floor corridor. They will be equally spaced with connections down through the ceiling of the corridor. A single and slightly smaller unit will be installed in a similar manner over the Fiscal Area, since it is cut off from the main corridor. The exhaust fans will be manually controlled, allowing them to be cut off and on individually as the need arises. With all fans running, and sufficient windows open, a complete air change will occur approximately every three minutes.

The exhaust fans will be installed by our maintenance people as soon as weather will permit cutting holes through the roof. It is planned to have the system in operation for the warm summer days which we hope will be here soon.

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Charlottesville vs. Green Bank

LEAGUE DATE , 19

TEAM			LANE				TEAM			LANE			
HDCP.	PLAYERS	1	2	3	TOTAL	HDCP.	PLAYERS	1	2	3	TOTAL
	Anderson	184	136	176	496		G. Calloway	120	110	109	339
	Stone	147	120	155	422		B. Calloway	170	134	213	517
	Monk	168	171	155	494		B. Parkinson	128	157	148	433
	Houston	159	119	169	447		B. Brown	130	147	159	436
	Spargo	156	170	187	513		G Tallman	147	151	160	458
		4									
	Tot. Hdcp. Sub Total	814	716	842	2372		Tot. Hdcp. Sub Total	695	699	789	2183
Games Won 3	Handicap	144	144	144	432	Games Won 1	Handicap	162	162	162	486
Games Lost 1	Tl. Inc. Hdcp.	958	860	986	2804	Games Lost 3	Tl. Inc. Hdcp.	857	861	951	2669

Indicate By (X) Games Won ☐ ☐ ☐ Indicate By (X) Games Won ☐ ☐ ☐

Captain Robert A Calloway Captain D B Houston

NRAO LEAGUE DATE 23 April , 1971

TEAM	Green Bank		LANE 13				TEAM	CV		LANE 14			
HDCP.	PLAYERS	1	2	3	TOTAL	HDCP.	PLAYERS	1	2	3	TOTAL
46	R. Poling	103	159	156	418	39	G Runion	189	149	135	473
39	B. Nichols	157	121	145	423	44	C Pace	135	97	153	385
39	L. Webb	156	143	119	412	59	J. Davis	105	118	165	388
40	W. Varable	126	141	123	390	43	B. Bulick	147	123	126	396
34	W Orcs	186	121	167	474	34	B. Meredith	148	122	126	396
										705	
198	Tot. Hdcp. Sub Total	728	685	710	2117	219	Tot. Hdcp. Sub Total	724	609	705	2038
Games Won	Handicap	198	198	198	594	Games Won	Handicap	219	219	219	657
Games Lost	Tl. Inc. Hdcp.	920	883	908	2711	Games Lost	Tl. Inc. Hdcp.	943	828	924	2695

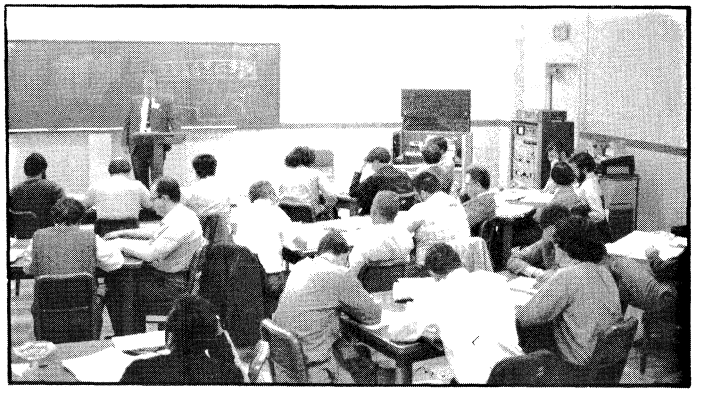
Indicate By (X) Games Won ☐ ☒ ☐ X Indicate By (X) Games Won ☒ ☐ ☒

Captain Glenn Runion Captain Robert P Poling

VLB TRAINING SCHOOL

George Grove

On April 16 and 17 the Observatory held a training session for users of the recently developed Mark II Very Long Baseline Interferometry Equipment.



The Mark II represents a considerable improvement over the Mark I system, having larger integration time available, greater bandwidth, and being cheaper, smaller, lighter, more versatile and more rugged. It was made feasible by current integrated circuit technology and the availability of reasonably priced video recorders.

Present plans call for the construction of more than ten record terminals, most of which will be more or less permanently located at various observatories and a couple built and specially packaged to be shipped about as the Mark I record units were.

There is at the moment only one playback terminal; this unit does the initial correlations of the data on the two video tapes produced by each antenna pair in about the same length of time it took to record them. This terminal is presently located in Green Bank, while both the software and hardware are being debugged.

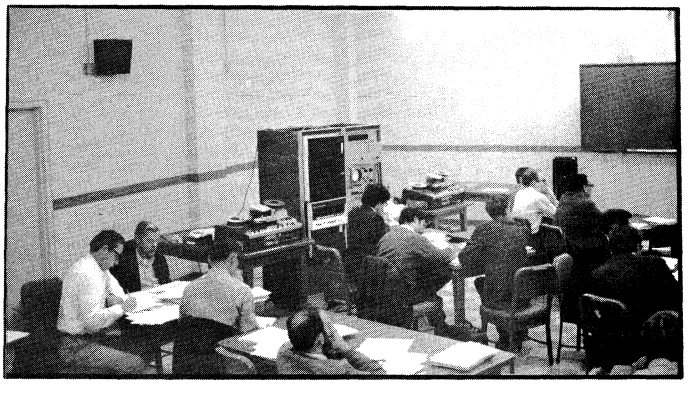
The video tape recorders used are modified Ampex model six sixties. It may be noted that this is the same recorder used by Hugh Hefner in his flying hutch, the "Big Bunny".

At the training session, Clark, Weimer and Weinreb covered both theoretical and practical aspects of the Mark II system in informal lectures. These were followed by short demonstrations of the operation of both record and playback terminals.

Students at the session were from NRAO, JPL, NOAA, NRL, MPI, MIT, Smithsonian, and the Universities of Maryland, Cornell, Illinois, Iowa, and California Institute of Technology.

Approximately 50 people attended the session.

Ron tells it like it is.



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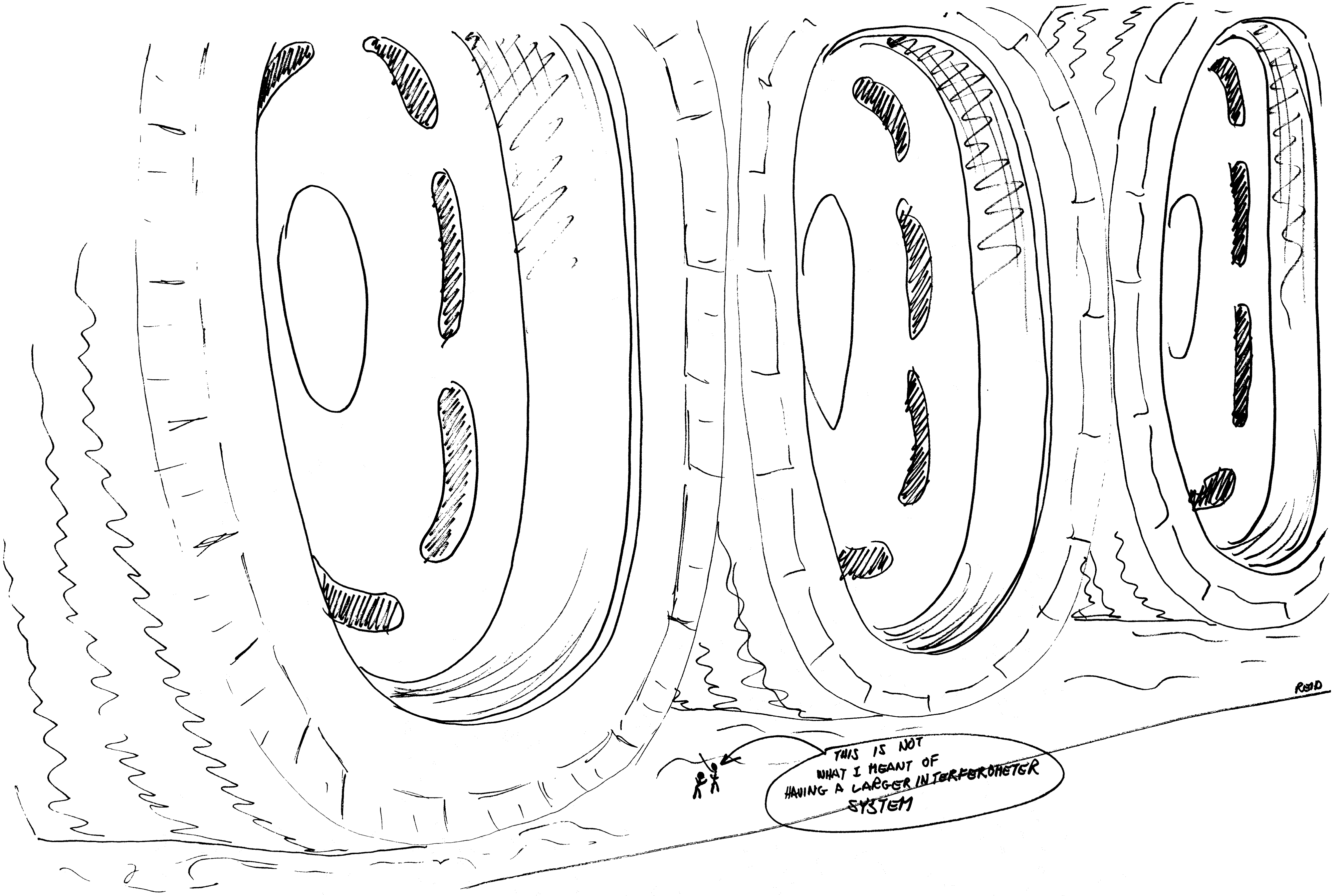
THIS IS NOT WHAT I MEANT OF HAVING A LARGER INTERFEROMETER SYSTEM
REED